The Nearby Supernova Factory

Greg Aldering (LBNL)

The Collaboration

Lawrence Berkeley National Lab

Laboratoire de Physique Nucleaire et de Haute Energies de Paris

Institut de Physique Nucleaire de Lyon

Centre de Recherche Astronomique de Lyon

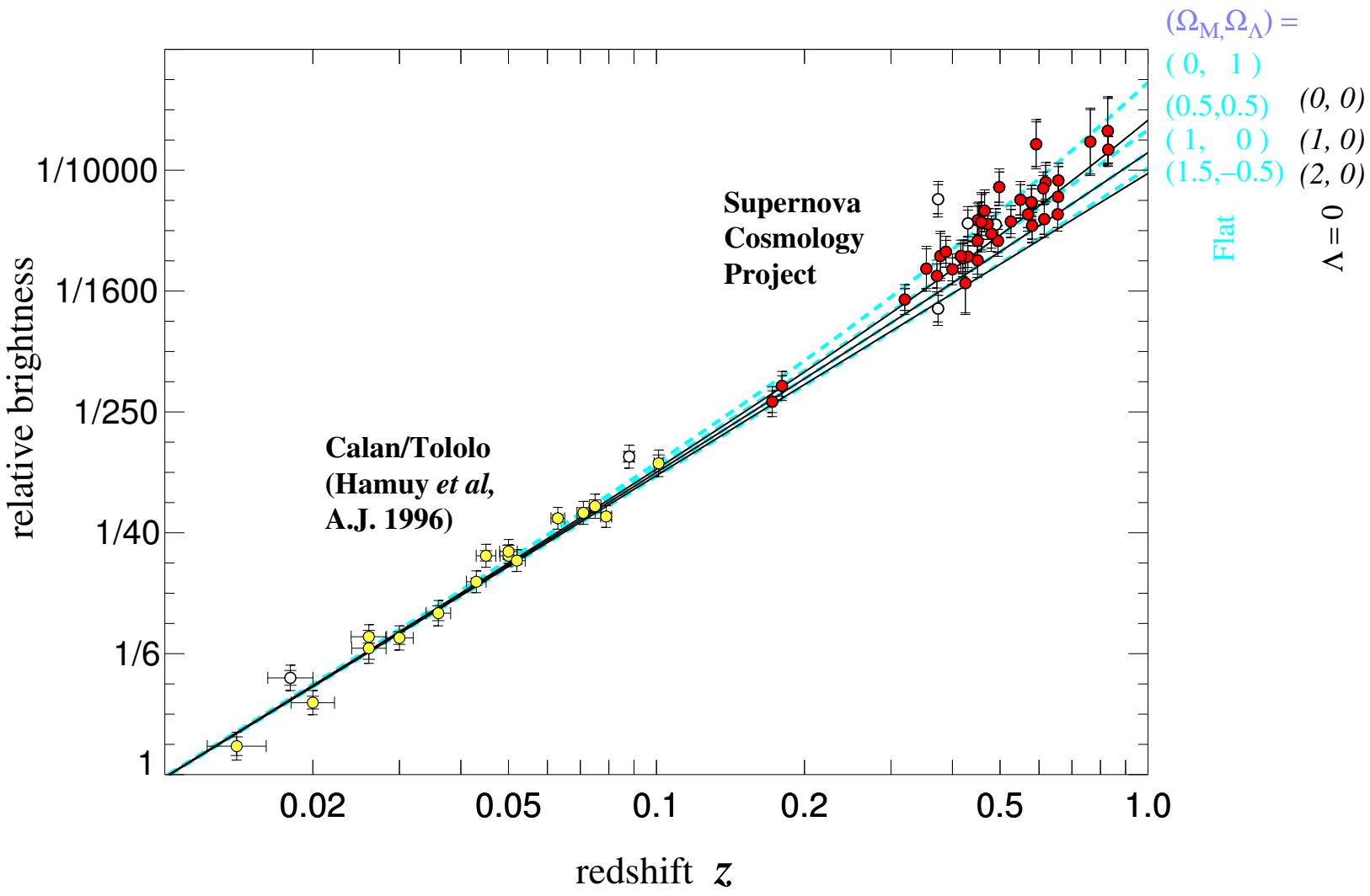
Kavli Institute for Cosmological Physics, University Chicago

Yale University — QUEST group

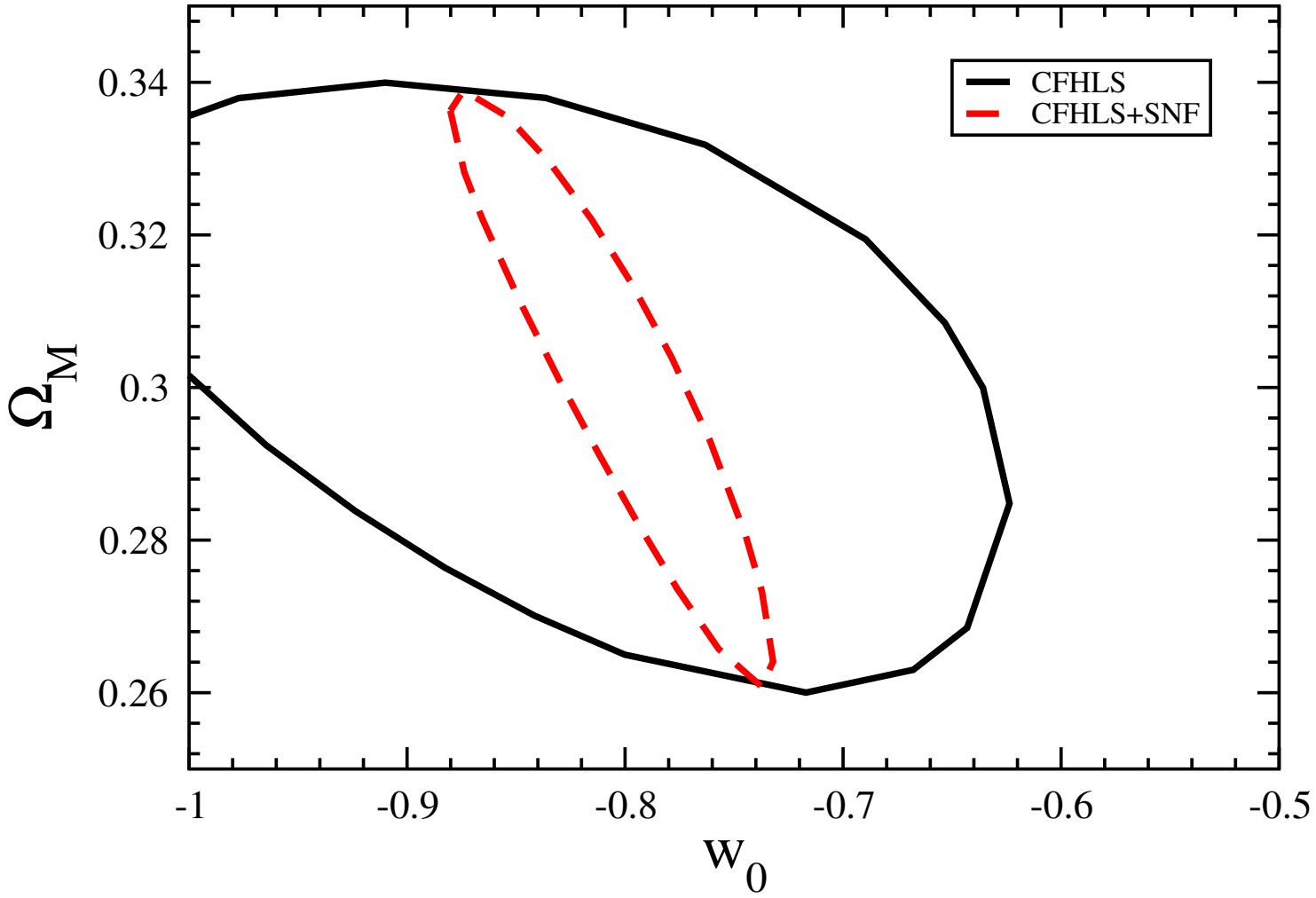
SNfactory Genesis

- Low-density universe measurement in fall 1997
- Discovery of accelerating universe in winter 1998
- First HST NIR SN observations in winter 1998
- First $z > 1$ Type Ia discovery in fall 1998
- Nearby SN campaign in winter/spring 1999
- SNfactory conceived spring 1999
- SNAP conceived spring 1999
- SNfactory/SNAP LDRD summer 1999

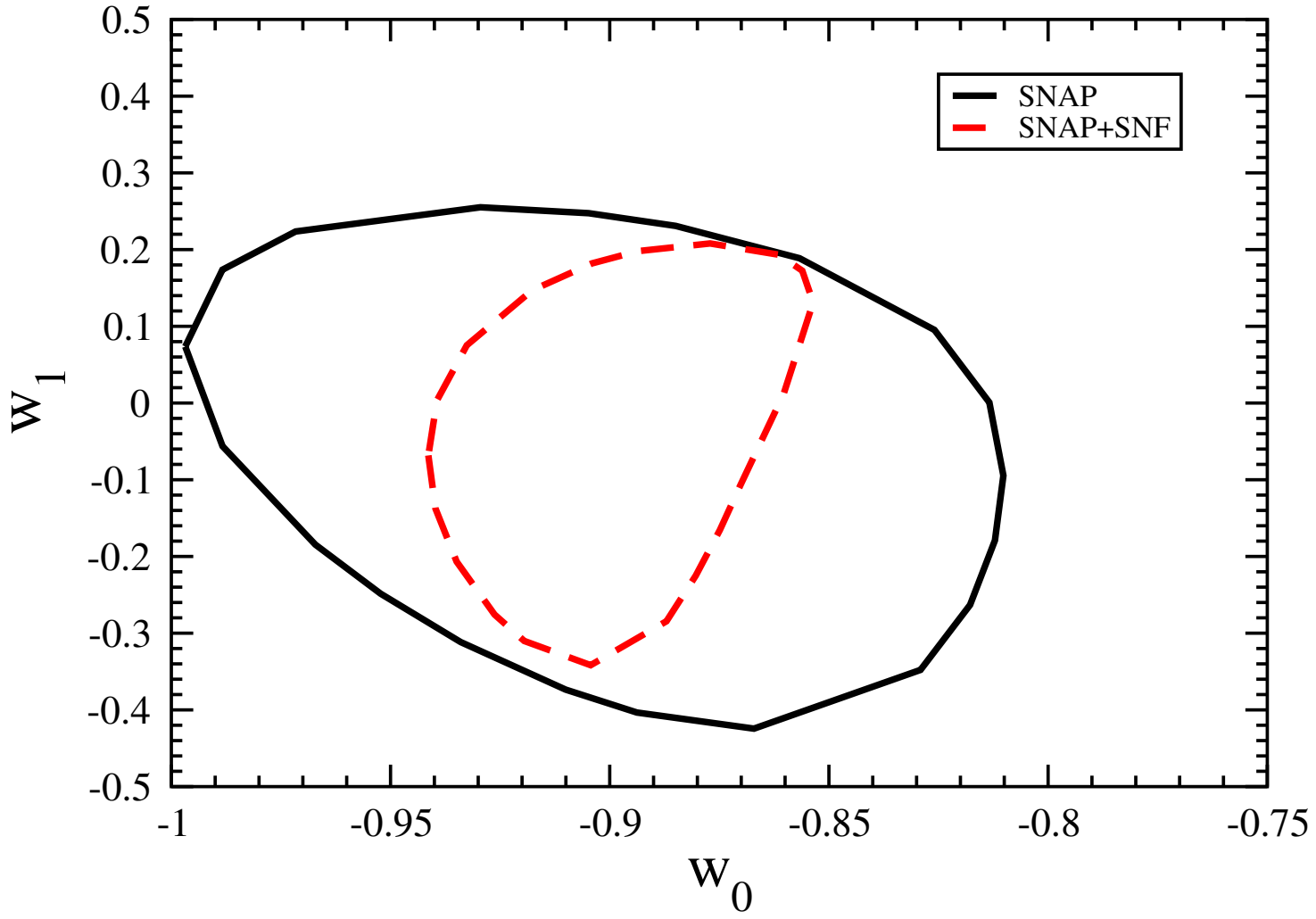
SCP Type Ia Supernova Hubble Diagram



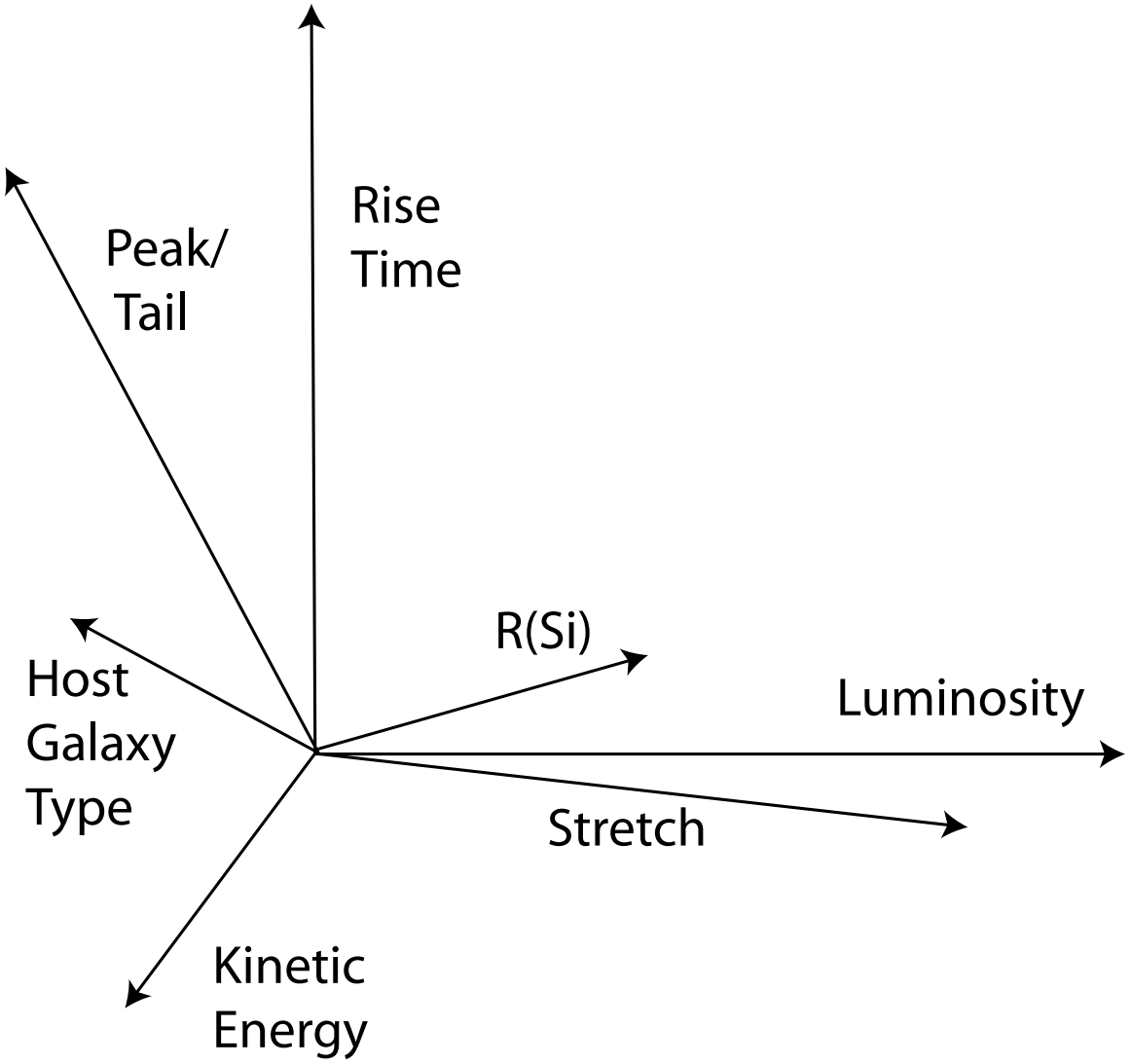
Combining SNfactory & SNLS



Combining SNfactory & SNAP

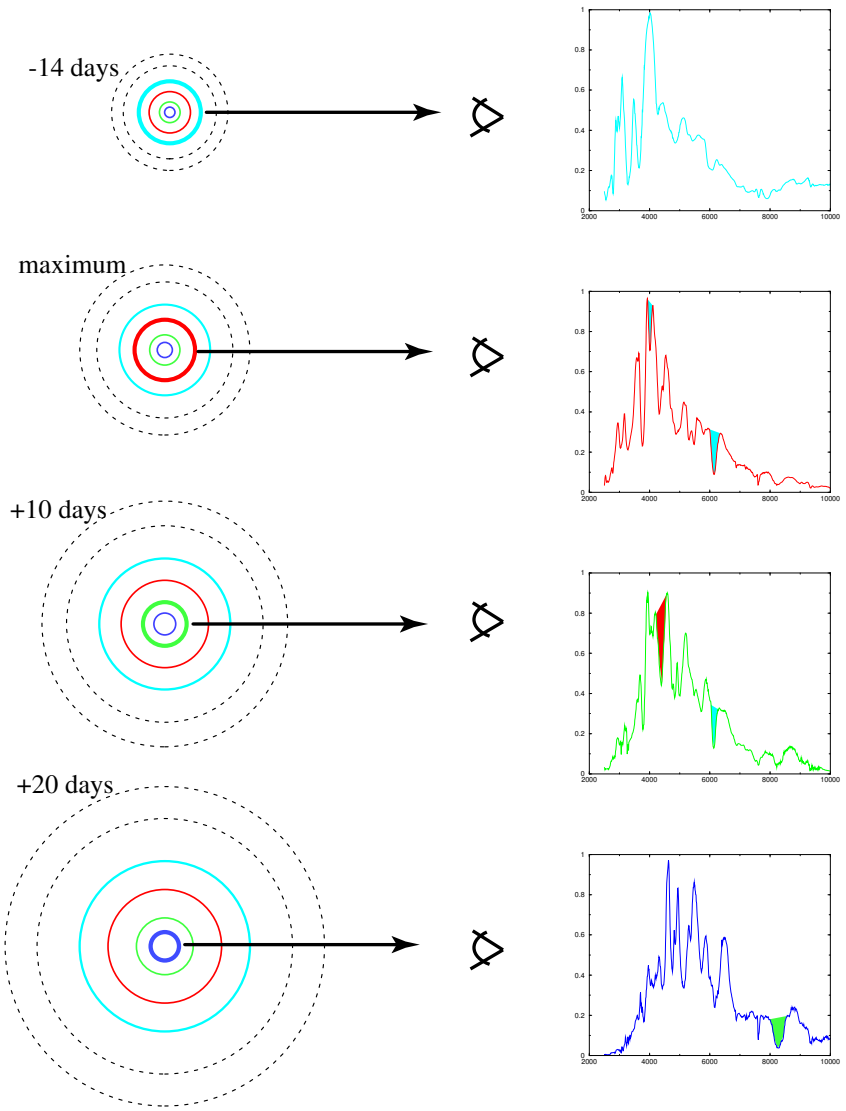


Large Sample Probes SN Parameter Space

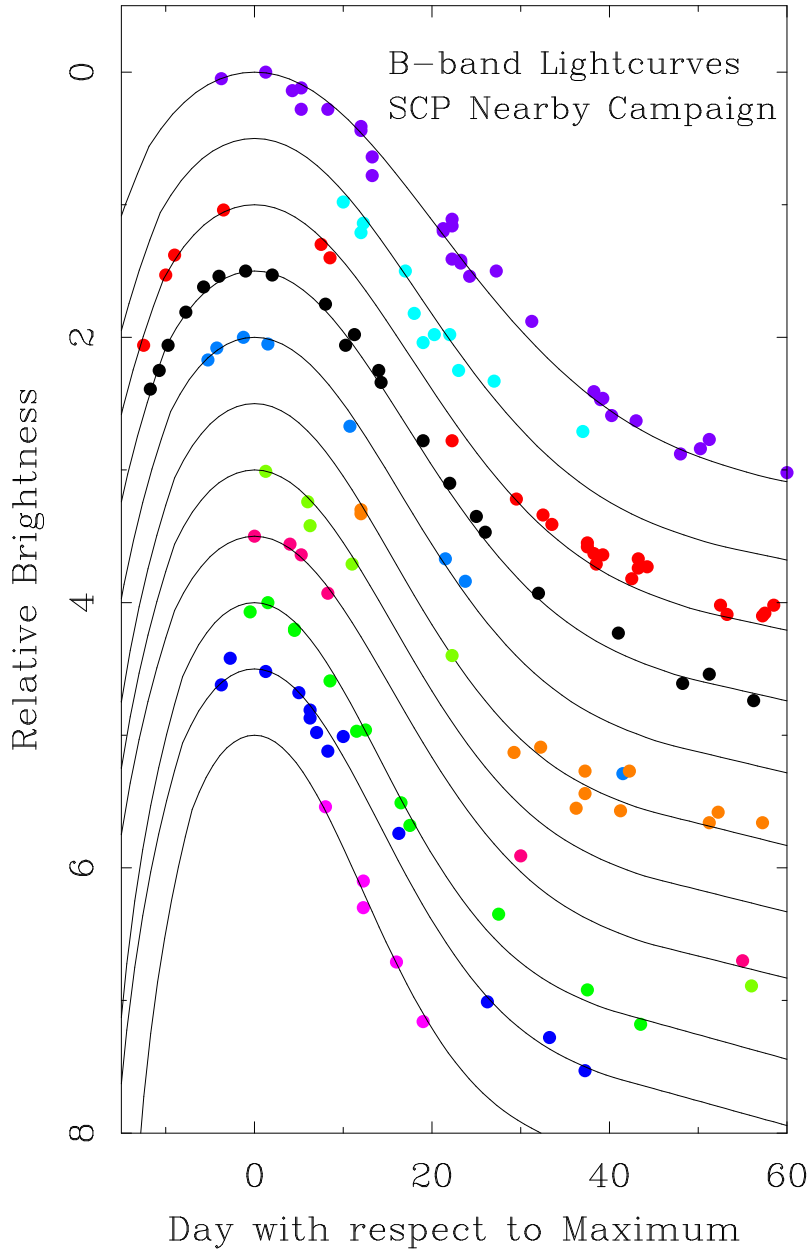


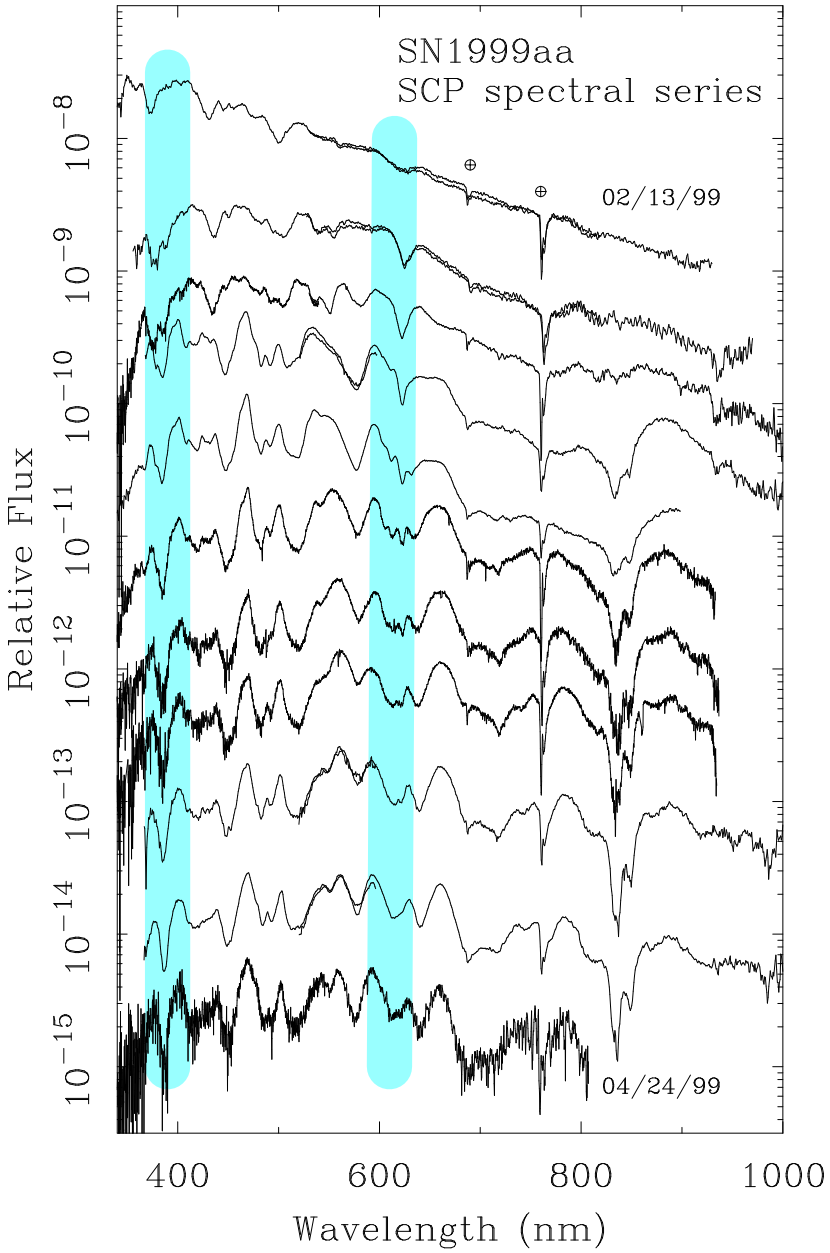
Spectroscopy Key to SN Physics

The time series of spectra is a “CAT Scan” of the Supernova



A Pilot Program: The SCP Spring 1999 Nearby Campaign





SNfactory Baseline Program

- 300 Type Ia supernova over 3.5 yrs
- Discovery via blind, wide-field CCD search
- Concentrate on nearby smooth Hubble-flow $0.03 < z < 0.08$
- Early discovery, 10–15 days before maximum

  - Flux-calibrated optical spectroscopy every 3–7 days
  - Follow-up from -15 to $+50$ days; more for nearer SNe
  - Lightcurve follow-up for $0.03 < z$ for peculiar velocities

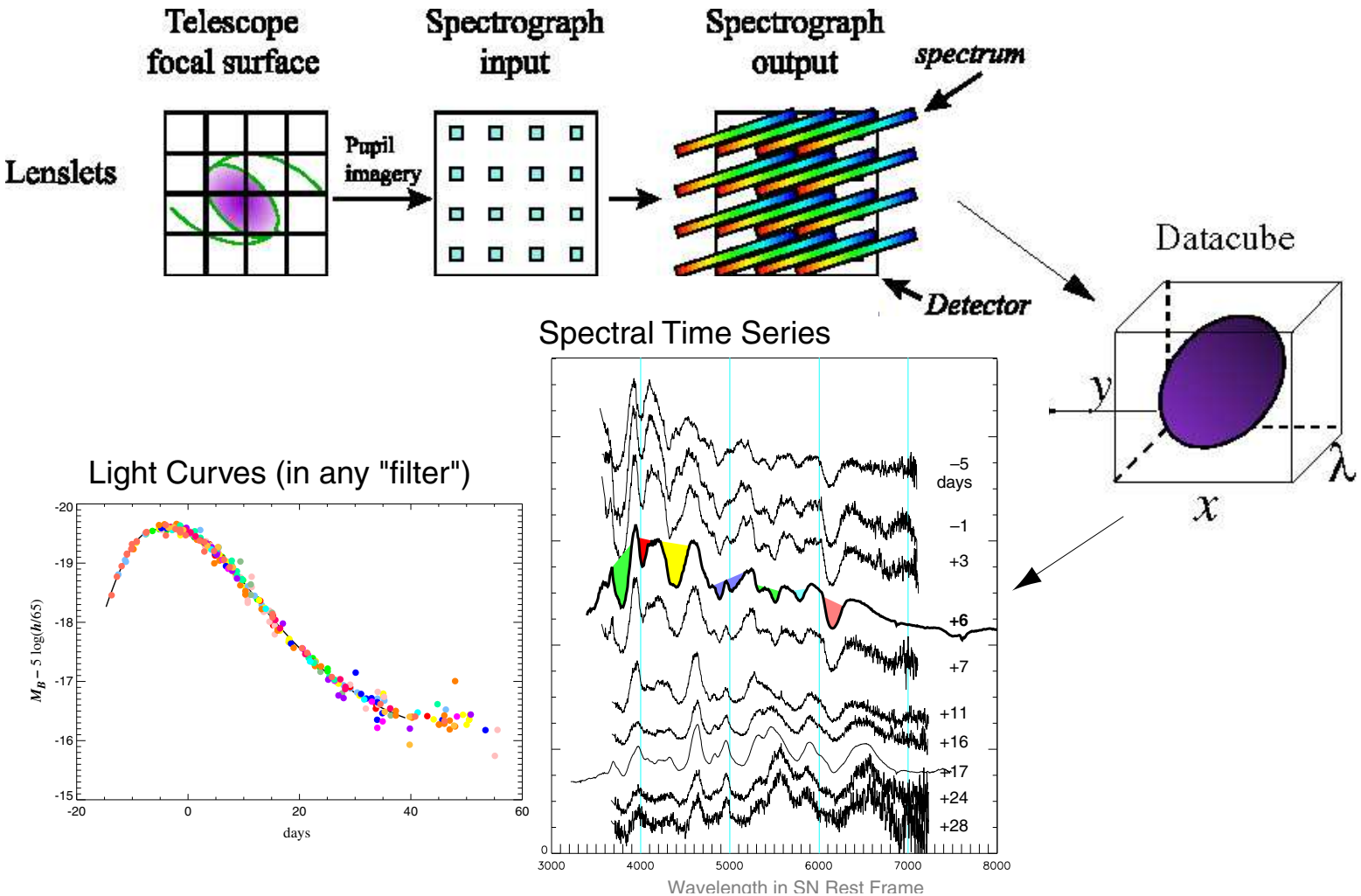
- UV spectroscopy for small subset using Hubble Space Telescope
- Near-infrared lightcurves and/or spectra for small subset

Implementation

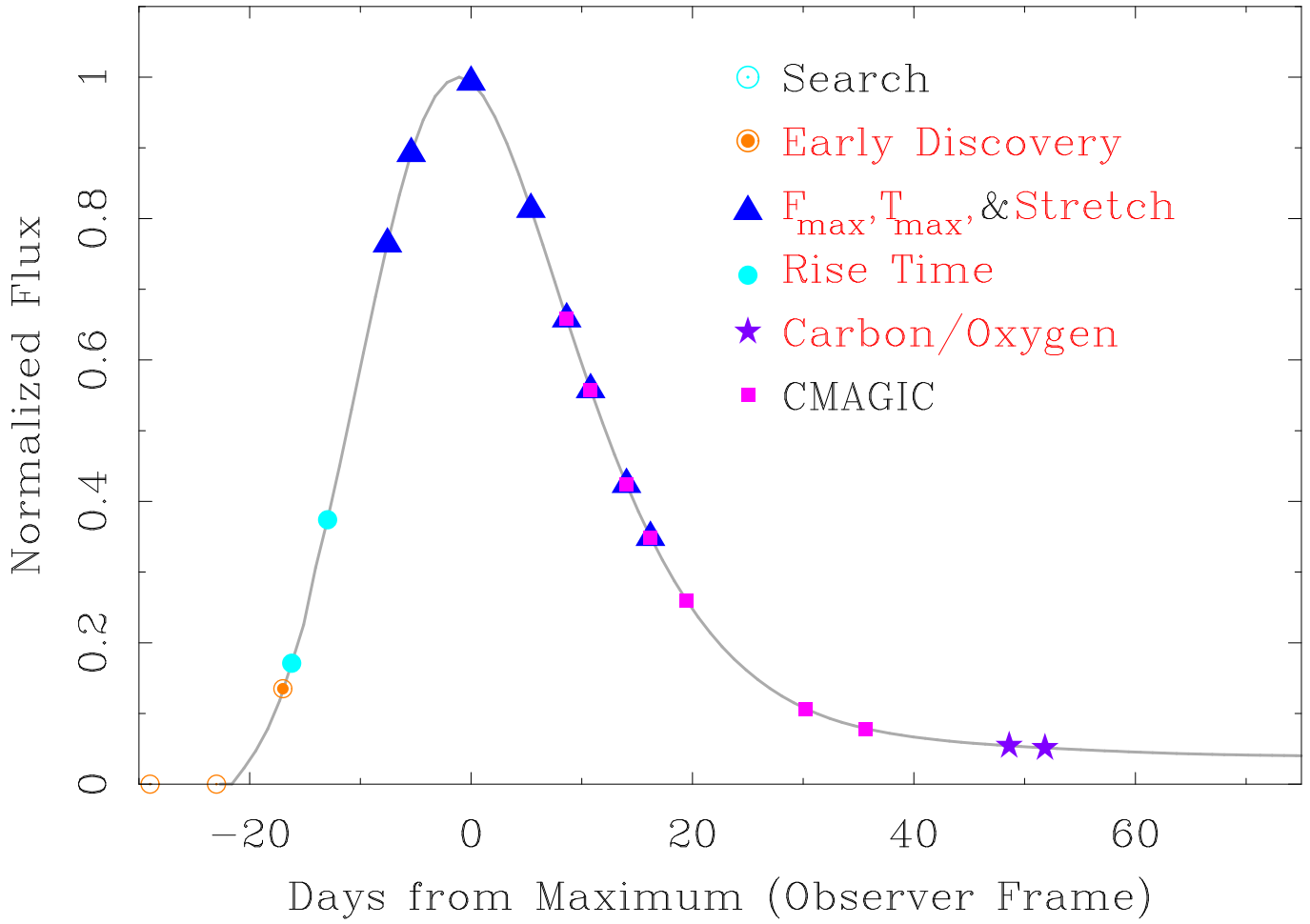
- LBL
  - — SN expertise, telescope time, search data access search implementation, CCD cameras
- France
  - — SN expertise, spectrograph expertise & implementation
- JPL & Yale
  - — Search cameras
- Chicago
  - — Flux calibration hardware and software

IFU Essential for Spectrophotometry

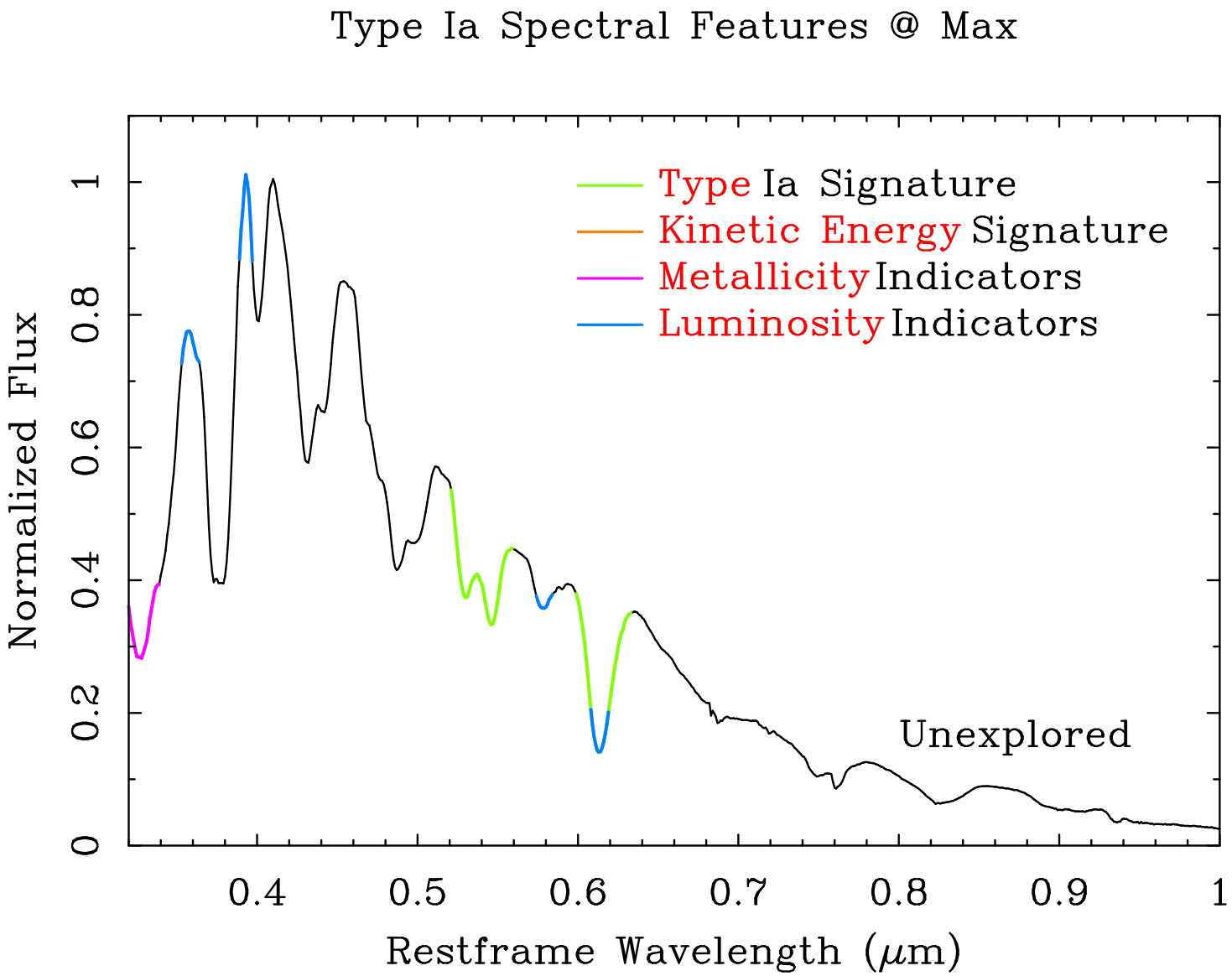
"Integral Field Unit" Spectrograph



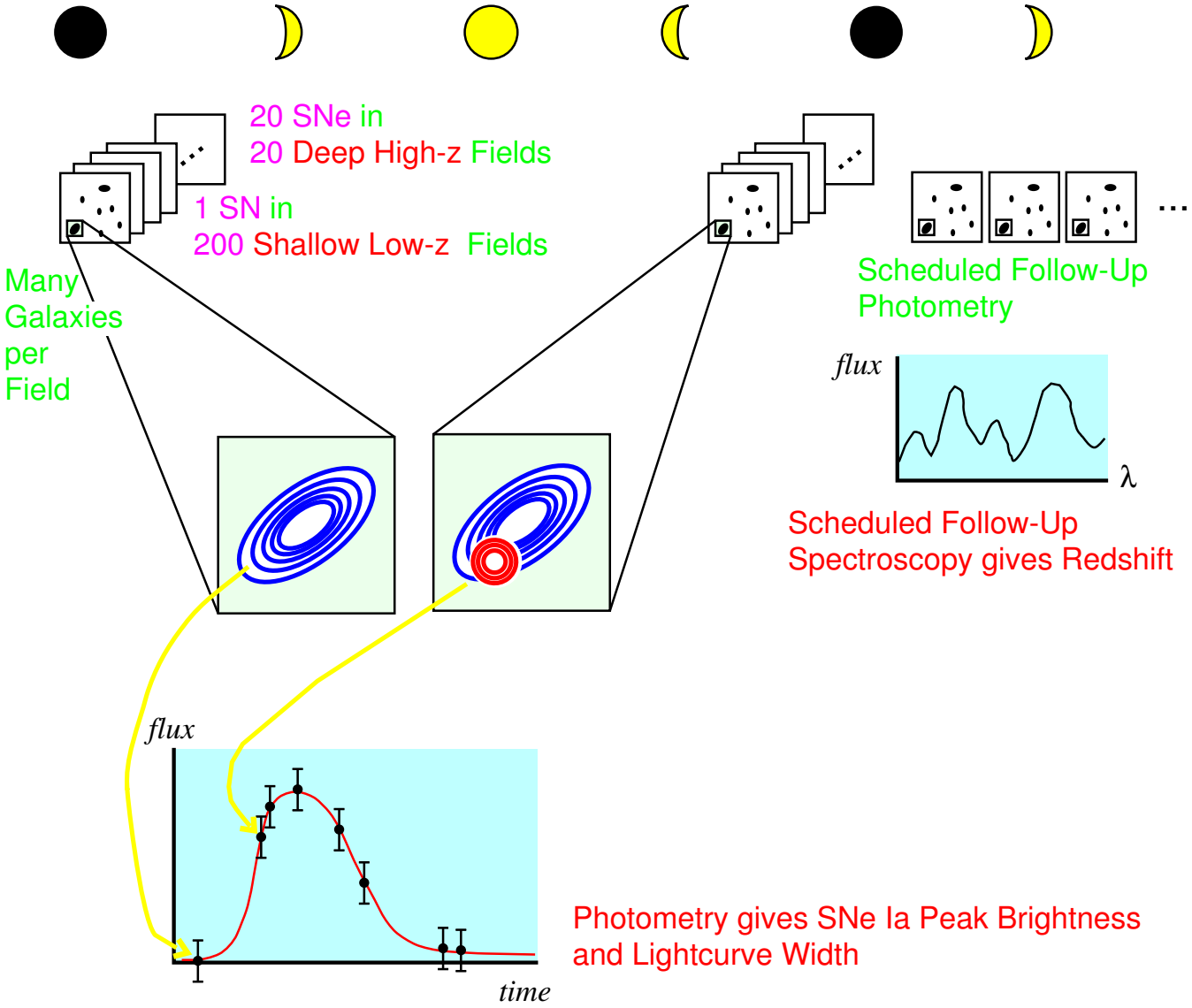
Schematic Dataset: Lightcurve



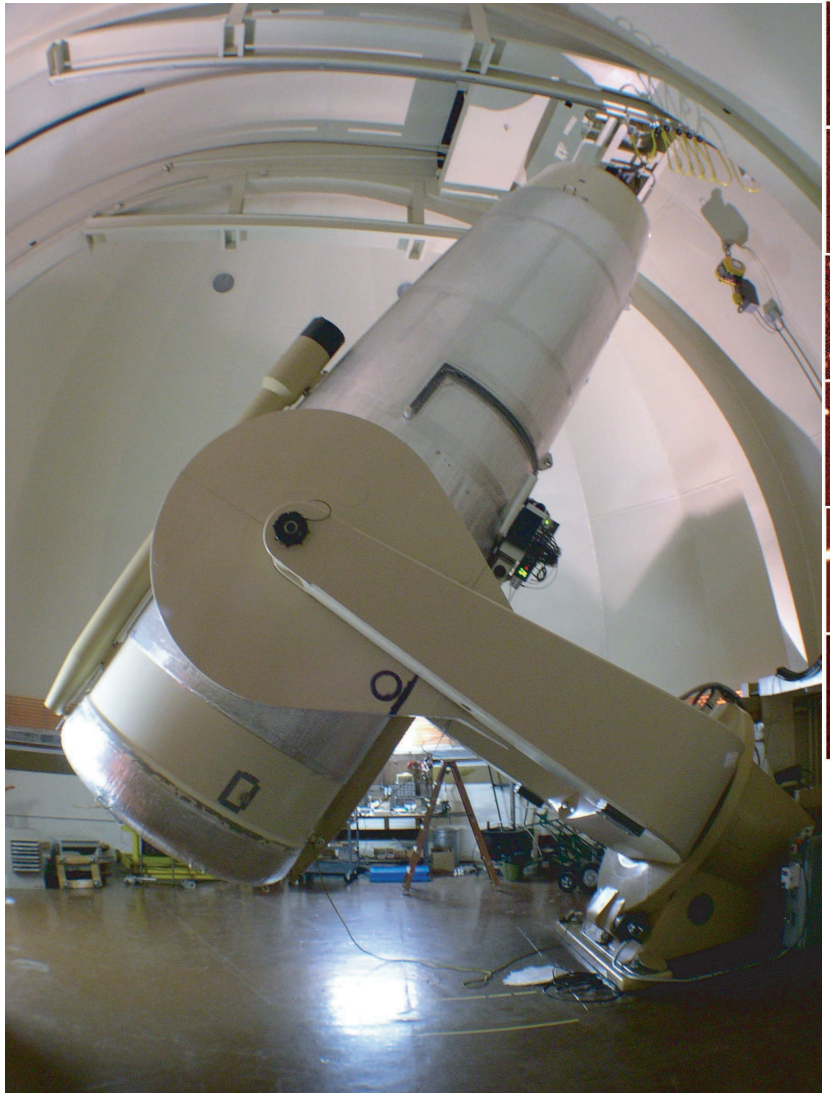
Schematic Dataset: Spectrum

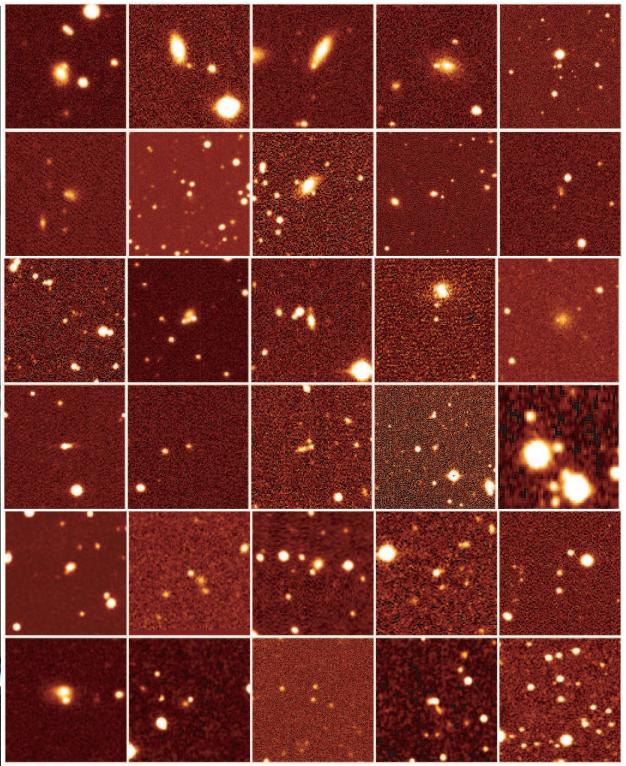


What's So Hard about Finding Low-Z SNe?



Search Camera & Pipeline Running

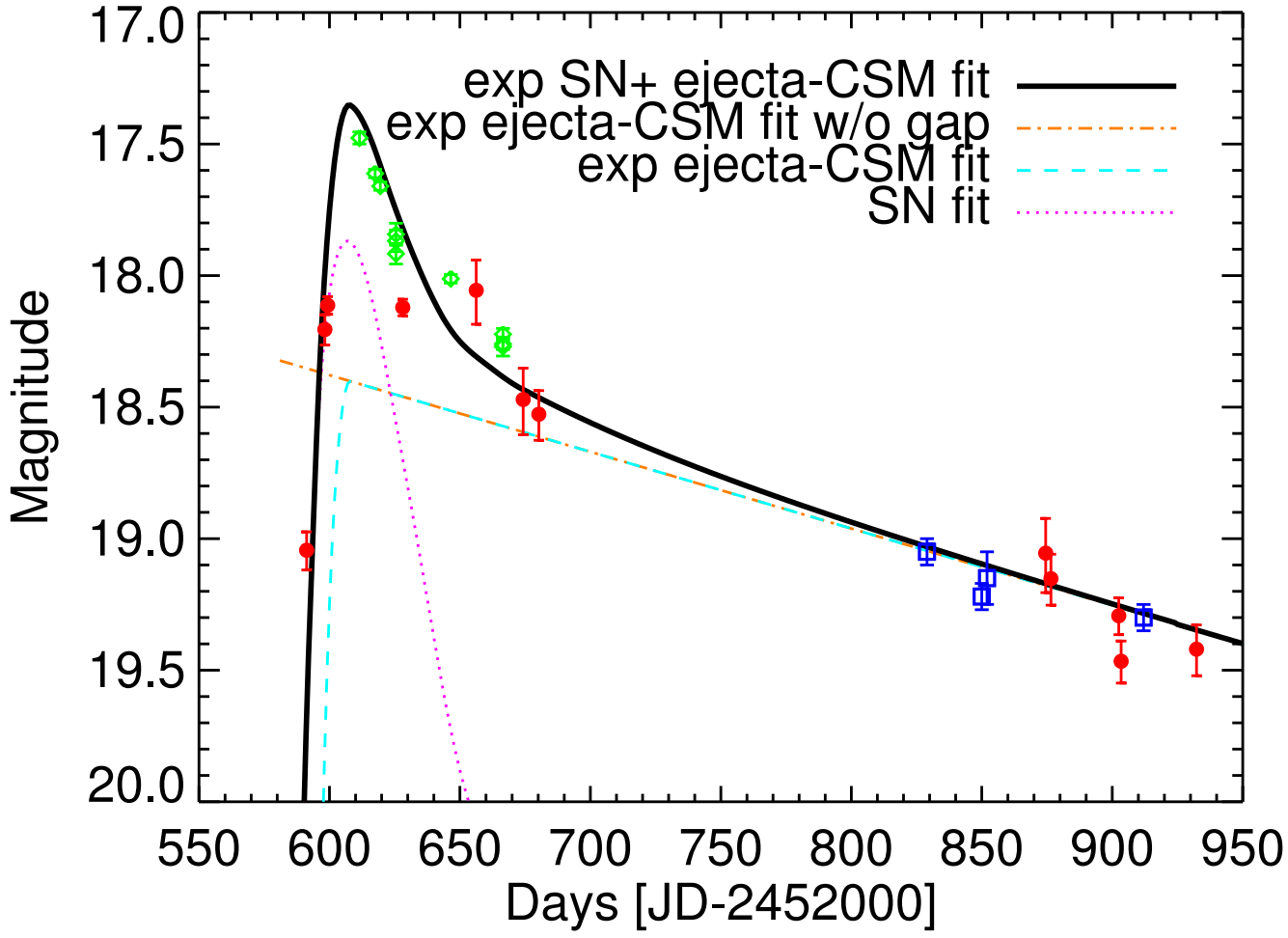




99 SNe in Wood-Vasey PhD thesis (2004)

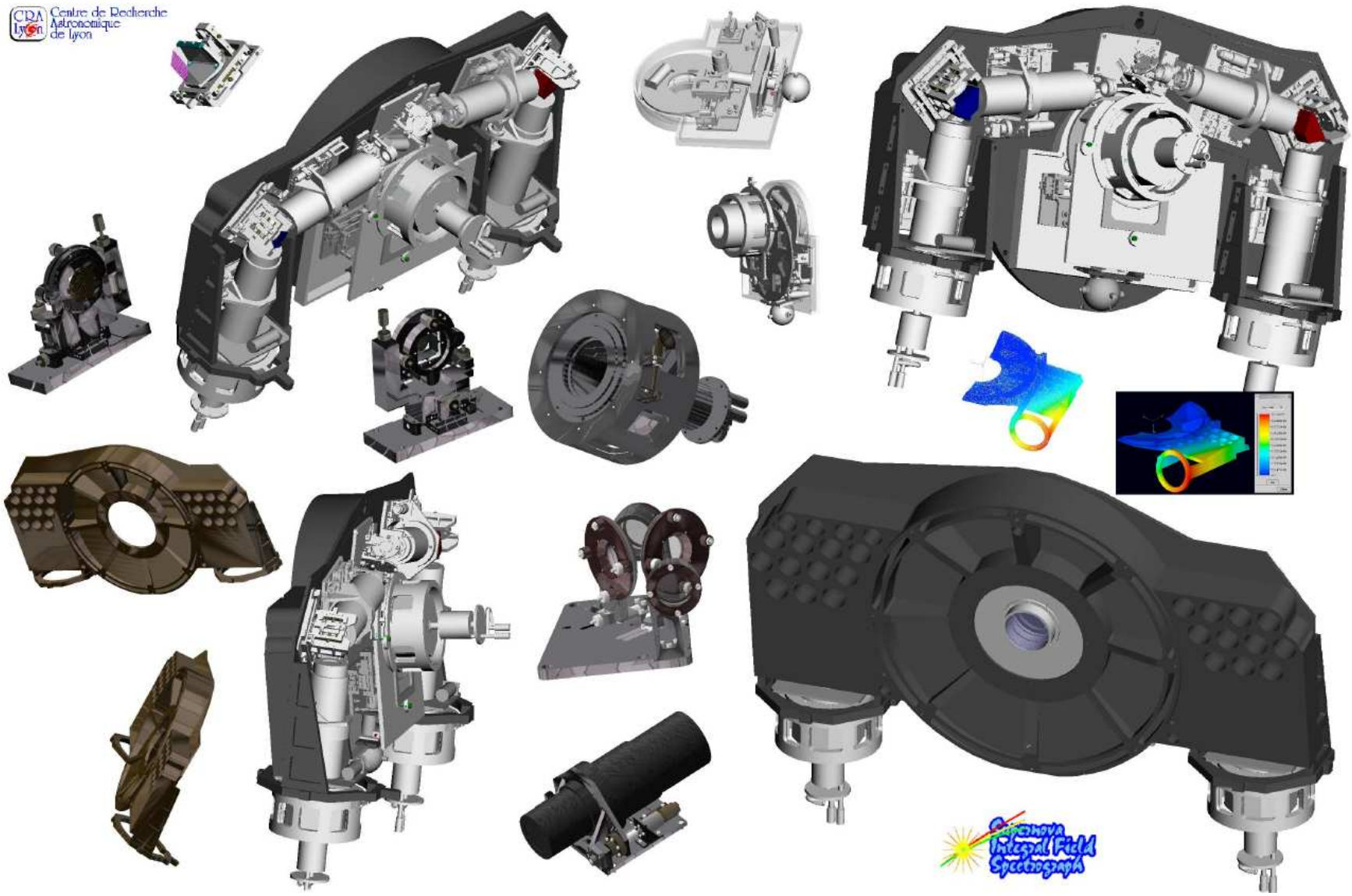
Best rookie year SN search in 2002

Discovery of SN2002ic — Type Ia with Hydrogen



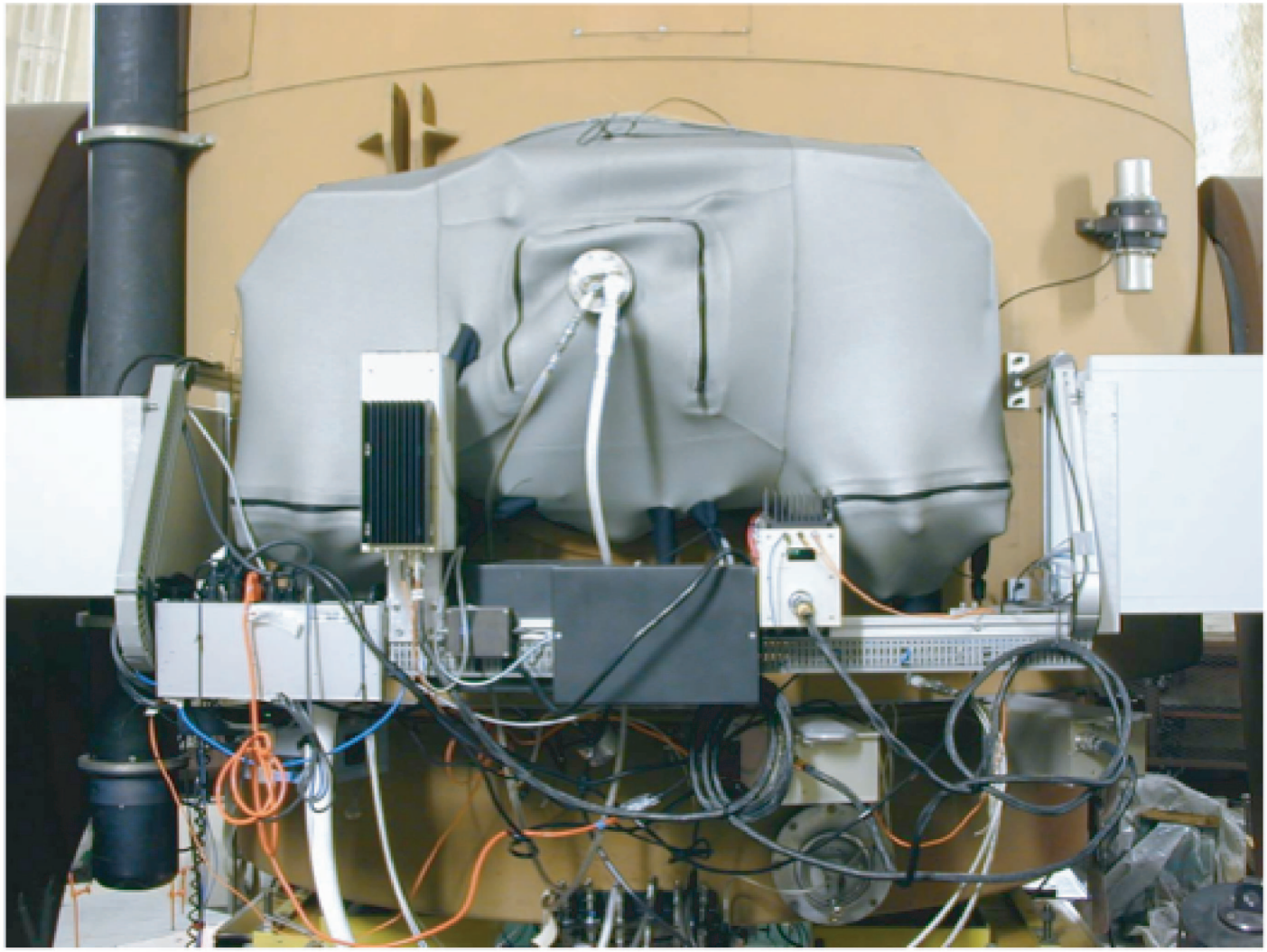
Wood-Vasey, Wang, & Aldering, *Astrophysical Journal*, Nov 20, 2004.

SNIFS Opto-mechanical Layout

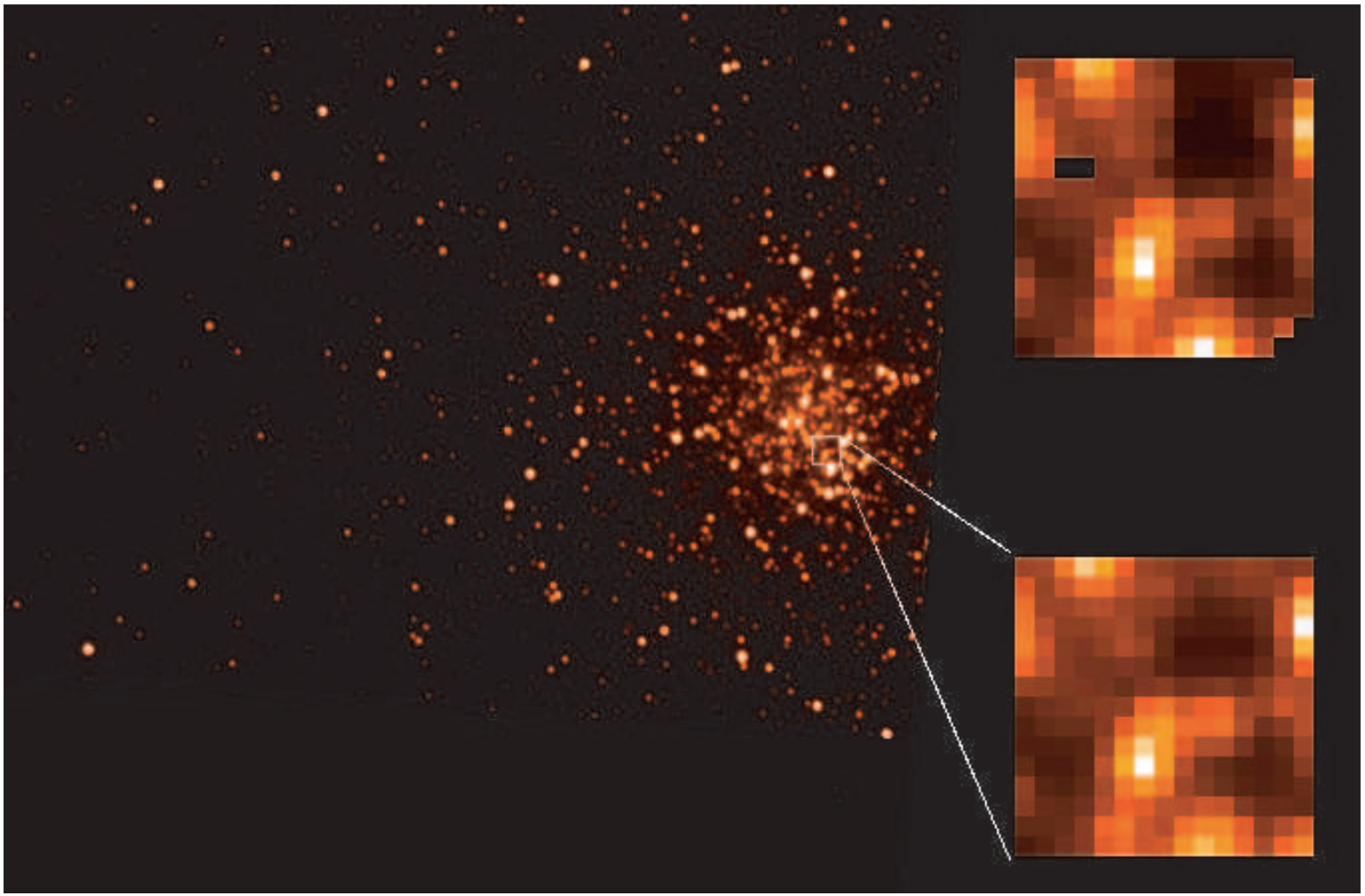


SNIFS Now Running

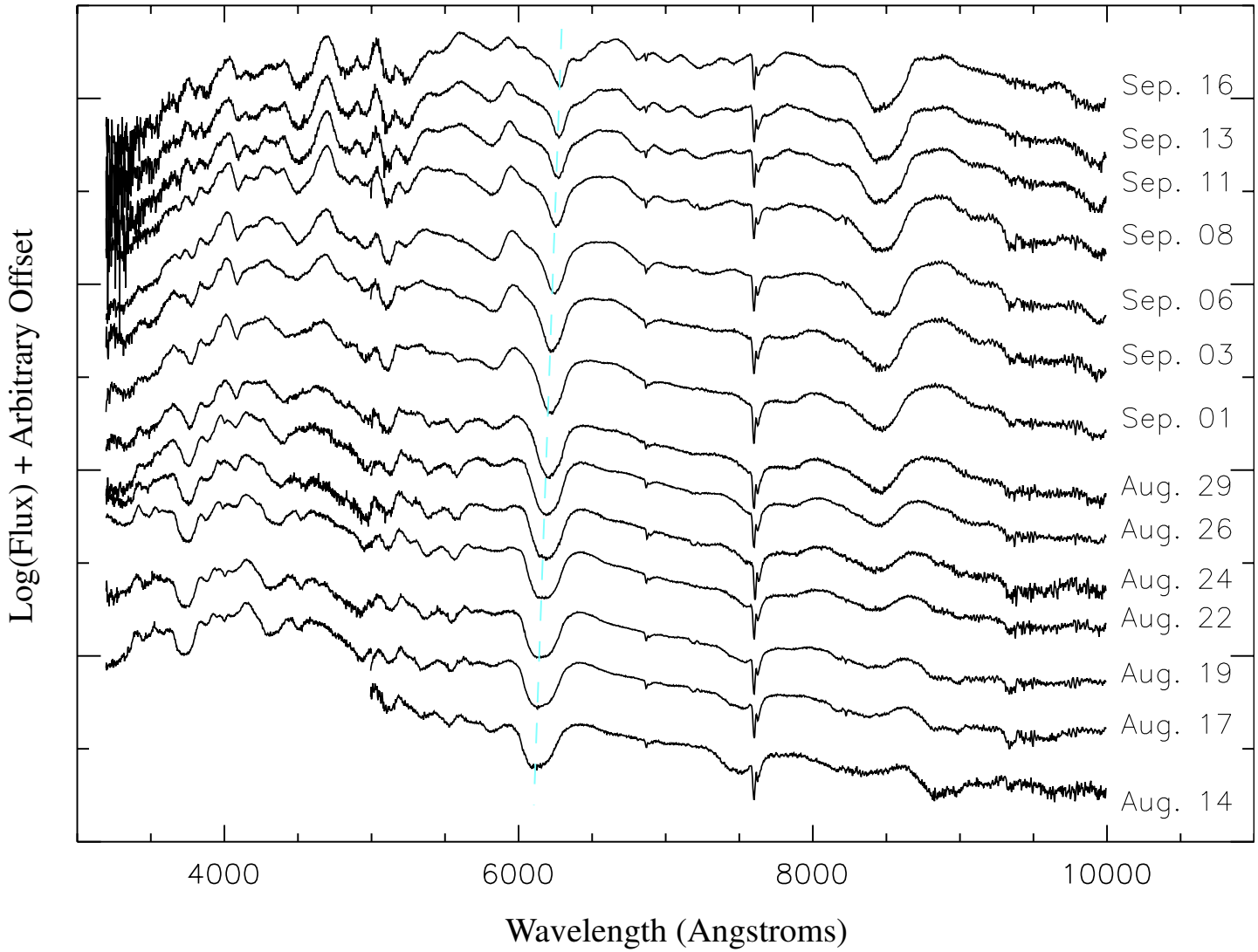
SNIFS on UH 2.2m Telescope



IFU Image Reconstruction Working



Spectral Time Series of SN2004dt



HST UV and Keck near-infrared observations as well

SNfactory Major Project Milestones

Date		Milestone
Summer	1999	Project inception
Fall	2000	Preliminary Agreement for UH Telescope
Fall	2000	SNIFS design begun
Spring	2001	France-Berkeley MOU
Summer	2001	Final Agreement for UH Telescope
Fall	2001	SNIFS construction begun
Spring	2002	SAGENAP review & endorsement
Summer	2003	QUEST-II Camera Operational
Spring	2004	SNIFS commissioned
Spring	2005	*SNfactory* steady-state operations
Spring	2008	Discovery stage completed (final refs continue)
Spring	2009	Observing operations completed
Spring	2010	Analysis operations completed

SNfactory — Past Year

Date		Milestone
November	2003	Photometry CCD camera working
February	2004	Primary SNIFS construction completed
March	2004	Red CCD camera working
March	2004	Blue CCD camera tune-up
March	2004	SNIFS delivery and integration in Hawaii
February	2004	Primary SNIFS construction completed
April	2004	SNIFS commissioned
May	2004	First SNIFS supernova observation
June	2004	Major allocations on HST, Keck, Gemini for UV/NIR
July	2004	Semi-automated operations begin
August	2004	Coordinated SNIFS optical / HST UV / Keck NIR obs.
September	2004	Automatable operations begin
September	2004	Moore Foundation grant awarded
October	2004	Physics Division review

Physics Division Review

Findings:

"The foremost finding of the Committee is that the project has made excellent progress over the last year." "... The Committee did however, identify several areas where substantial progress is still required before the project can be considered operational and on track for satisfying the scientific goals."

Recommendations:

- Currently effort-limited, so fill Moore positions.
- Address inefficiency in search pipeline, inc. better diagnostics and more manpower.
- Prioritize short-term vs. long-term goals — develop contingency
- Address funding shortfall given likely need for more telescope time than currently budgeted.

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